Experiment
13

Properties of Acids

In this experiment, you will discover some properties of acids as strong electrolytes and weak electrolytes by observing the behavior of these substances in aqueous solutions. You will determine these properties using a Conductivity Probe. When the probe is placed in a solution that contains ions, and thus has the ability to conduct electricity, an electrical circuit is completed across the electrodes that are located on either side of the hole near the bottom of the probe body (see Figure 1). This results in a conductivity value that can be read by the computer. The unit of conductivity used in this experiment is the microsiemens, or µS.

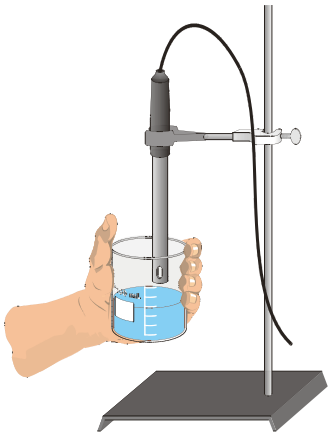

Figure 1

The size of the conductivity value depends on the ability of the aqueous solution to conduct electricity. Strong electrolytes produce large numbers of ions, which results in high conductivity values. Weak electrolytes result in low conductivity.

Molecular Acids

These are molecules that can partially or wholly dissociate, depending on their strength.

Example: Strong electrolyte $HBr \longrightarrow H^+(aq) + Br^-(aq)$ (100% dissociation)

Example: Weak electrolyte $HF \longleftrightarrow H^+(aq) + F^-(aq)$ (<100% dissociation)

MATERIALS

Power Macintosh or Windows PC
Vernier computer interface
Logger*Pro*
Vernier Conductivity Probe
250-mL beaker
wash bottle with distilled water
tissues
ring stand
utility clamp
H_2O (tap)
H_2O (distilled)
0.05 M $HC_2H_3O_2$
0.05 M H_2SO_4
0.05 M HNO_3
0.05 M HCl

PROCEDURE

1. Obtain and wear goggles! **CAUTION:** Handle the solutions in this experiment with care. Do not allow them to contact your skin. Notify your teacher in the event of an accident.
2. Prepare the computer to monitor conductivity by opening the file in the Experiment 13 folder of *Chemistry with Computers*. The Meter window will display live conductivity readings, in units of microsiemens (μS).
3. The Conductivity Probe is already attached to the interface box and computer. It should be set on the 0-20,000 μS position.
4. Obtain the four acid containers. These include 0.05 M H_2SO_4, 0.05 M $HC_2H_3O_2$, 0.05 M HNO_3, and 0.05 M HCl.
5. Measure the conductivity for each of the solutions.
   a. Carefully raise each vial and its contents up around the Conductivity Probe until the hole near the probe end is completely submerged in the solution being tested. **Important:** Since the two electrodes are positioned on either side of the hole, this part of the probe must be completely submerged.
   b. Briefly swirl the beaker contents. Once the conductivity reading in the Meter window has stabilized, record the value in your data table.
   c. Before testing the next solution, clean the electrodes by surrounding them with a 250-mL beaker and rinse them with distilled water from a wash bottle. Blot the outside of the probe end dry using a tissue. It is *not* necessary to dry the *inside* of the hole near the probe end.
   d. After rinsing your probe thoroughly with distilled water, measure the conductivity of distilled water as your baseline.

DATA TABLE

Solution	Conductivity (μS)
$HC_2H_3O_2$	
HCl	
H_2SO_4	
HNO_3	
$H_2O_{distilled}$	

PROCESSING THE DATA

1. Which acids are strong acids, and which are weak acids? Classify each, and arrange them from the strongest to the weakest, based on conductivity values.
2. Write an equation for the dissociation of each of the acids. Use $\longrightarrow$ for strong; $\longleftrightarrow$ for weak.